

The invention claimed is:

1. A hydraulically actuated medical instrument, comprising:  
an elongated shaft including a proximal end and a distal end;  
an end effector at the distal end of the elongated shaft;  
a handle portion at the proximal end of the elongated shaft;  
and  
a fluid flow path extending between the handle portion and the end effector through the elongated shaft.
2. The medical instrument of claim 1, further comprising at least one articulation joint located at a selected location between the handle portion and the end effector.
3. The medical instrument of claim 2, wherein the articulation joint is disposed between the proximal end of the elongated shaft and the handle portion to permit articulation between the elongated shaft and the handle portion.
4. The medical instrument of claim 2, wherein the articulation joint is disposed between the distal end of the elongated shaft and the end effector to permit articulation between the elongated shaft and the end effector.

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5. The medical instrument of claim 2, wherein a first articulation joint is disposed between the proximal end of the elongated shaft and the handle portion to permit articulation between the elongated shaft and the handle portion, and a second articulation joint is disposed between the distal end of the elongated shaft and the end effector to permit articulation between the elongated shaft and the end effector.

6. The medical instrument of claim 1, wherein at least a portion of the fluid flow path is flexible.

7. The medical instrument of claim 2, wherein the fluid flow path comprises a flexible portion in proximity to the articulation joint.

8. The medical instrument of claim 2, wherein the articulation joint is adapted to permit 360° of articulation.

9. The medial instrument of claim 8, wherein the articulation joint is a ball and socket type joint.

10. The medical instrument of claim 2, wherein the articulation joint is adapted to permit lateral articulation within a plane.

11. The medical instrument of claim 10, wherein the articulation joint is a hinge type articulation joint.

12. The medical instrument of claim 2, further comprising a control wire extending between the handle portion and the articulation joint to control articulation of the articulation joint.

13. The medical instrument of claim 1, further comprising at least a pair of fluid flow paths extending between the handle portion and the end effector through the elongated shaft.

14. A hydraulically actuated medical instrument, comprising:  
a handle portion;  
an end effector carried by the handle portion;  
the end effector including first and second hydraulic actuators, responsive to changes in hydraulic actuation pressure;  
a first hydraulic fluid flow path and a second hydraulic fluid flow path communicating between the handle portion and the first and second hydraulic actuators, respectively; and,  
the handle portion including first and second hydraulic pressure sources communicating with the first and second fluid flow

paths, respectively, for changing the hydraulic pressure within each of the first and second flow paths.

15. The medical instrument of claim 14, wherein the end effector includes first and second relatively movable jaws.

16. The medical instrument of claim 15, wherein the first hydraulic actuator is adapted to move the first and second jaws toward and away from one another.

17. The medical instrument of claim 14, wherein the end effector includes a plurality of staples carried by the first jaw and a staple anvil carried by the second jaw.

18. The medical instrument of claim 17, wherein the plurality of staples are contained in a supply cartridge removably carried by the first jaw.

19. The medical instrument of claim 17, wherein the second hydraulic actuator is adapted to force the staples from the first jaw and against the anvil of the second jaw.

20. The medical instrument of claim 19, wherein the first jaw includes a moveable staple ejector and the second actuator includes a linearly extensible balloon engageable with the staple ejector to force the staples from the first jaw upon increase of hydraulic pressure in the balloon.

21. The medical instrument of claim 16, wherein the first hydraulic actuator includes a longitudinally moveable piston and a connecting linkage associated with the piston and cooperative with each of the first and second jaws to move them toward one another upon increase of hydraulic pressure in the first hydraulic actuator.

22. The medical instrument of claim 16, wherein the first actuator is biased to a position in which the first and second jaws are spaced apart.

23. The medical instrument of claim 14, further comprising an articulation joint disposed between the end effector and the handle portion to permit articulation between the end effector and the handle portion.

24. The medical instrument of claim 23, wherein at least a portion of each of the first and second fluid flow paths are flexible.

25. The medical instrument of claim 24, wherein the first and second fluid flow paths comprise a flexible portion in proximity to the articulation joint.

26. The medical instrument of claim 23, wherein the articulation joint is adapted to permit 360° of articulation.

27. The medial instrument of claim 26, wherein the articulation joint is a ball and socket type joint.

28. The medical instrument of claim 23, wherein the articulation joint is adapted to permit lateral articulation within a plane.

29. The medical instrument of claim 28, wherein the articulation joint is a hinge type articulation joint.

30. The medical instrument of claim 23, further comprising a control wire extending between the handle portion and the articulation joint to control articulation of the articulation joint.

31. The medical instrument of claim 14, wherein the hydraulic pressure source further comprises a movable lever cooperative with one of the pressure sources for changing the hydraulic pressure source in one of the fluid flow paths.

32. The medical instrument of claim 31, wherein the handle portion further comprises:

a hydraulic cylinder block communicating with at least one of the hydraulic fluid flow paths;

a longitudinally moveable piston slidably movable with respect to the cylinder block for movement between at least a higher pressure position and a lower pressure position; and

the lever being pivotally mounted and engageable with the piston for moving the piston relative to the cylinder hydraulic block to change the pressure of the hydraulic fluid in at least one fluid flow path.

33. The medical instrument of claim 32, wherein the piston further comprises a plurality of gear teeth and the lever includes a plurality of gear teeth engageable with the gear teeth of the piston.

34. The medical instrument of claim 31, wherein the lever is biased to a position of lower hydraulic pressure.

35. The medical instrument of claim 34, wherein the handle portion further comprises a release tab operable to engage the lever to hold it in an increased pressure state.

36. The medical instrument of claim 31, wherein the end effector includes first and second relatively movable jaws.

37. The medical instrument of claim 32, wherein the lever is adapted to move the first and second jaws toward and away from one another.

38. The medical instrument of claim 14, wherein the hydraulic pressure source further comprises a trigger cooperative with one of the pressure sources for changing the hydraulic pressure source in at least one of the fluid flow paths.

39. The medical instrument of claim 38, wherein the handle portion further comprises:

a hydraulic cylinder block communicating with one of the hydraulic fluid flow paths;



a longitudinally moveable piston slidably movable with respect to the cylinder block for movement between at least a higher pressure position and a lower pressure position; and

the trigger being pivotally mounted and engageable with the piston for moving the piston relative to the hydraulic cylinder block to change the pressure of the hydraulic fluid in at least one fluid flow path.

40. The medical instrument of claim 39, wherein the piston further comprises a plurality of gear teeth and the trigger includes a plurality of gear teeth engageable with the gear teeth of the piston.

41. The medical instrument of claim 39, wherein the handle portion further comprises a safety latch engageable with the trigger to hold the trigger in a lower pressure position.

42. The medical instrument of claim 38, wherein the end effector includes a plurality of staples carried by the first jaw and a staple anvil carried by the second jaw.

43. The medical instrument of claim 42, wherein the trigger is adapted to force the staples from the first jaw and against the anvil of the second jaw.

44. The medical instrument of claim 14, wherein the handle portion further comprises:

a hydraulic cylinder block including first and second cylinders communicating with the first and second hydraulic fluid flow paths, respectively;

first and second longitudinally moveable pistons slidably movable with respect to the first and second cylinders, respectively;

a movable lever pivotally mounted and engageable with the first piston for moving the first piston relative to the cylinder block to increase the pressure of the hydraulic fluid in the first fluid flow path; and

a trigger pivotally mounted and engageable with the second piston for moving the second piston relative to the cylinder block to increase the pressure of the hydraulic fluid in the second fluid flow path.

45. The medical instrument of claim 44, wherein the first and second pistons each further comprise a plurality of gears engageable with the lever and trigger, respectively.

46. The medical instrument of claim 44, wherein the lever is biased to a position in which the first fluid flow path is at a reduced hydraulic pressure state.

47. The medical instrument of claim 44, wherein the handle portion further comprises a release tab operable to engage the lever when it is in an increased pressure state.

48. The medical instrument of claim 44, wherein the handle portion further comprises a safety latch engageable with the trigger to hold the trigger in a reduced pressure position.

49. The medical instrument of claim 44, wherein the end effector includes first and second relatively movable jaws.

50. The medical instrument of claim 50, wherein the lever is adapted to move the first and second jaws toward and away from one another.

51. The medical instrument of claim 44, wherein the end effector includes a plurality of staples carried by the first jaw and a staple anvil carried by the second jaw.

52. The medical instrument of claim 51, wherein the trigger is adapted to force the staples from the first jaw and against the anvil of the second jaw.

53. A hydraulically actuated end effector for an endoscopic medical instrument, the end effector comprising a first hydraulic actuator responsive to changes in hydraulic actuation pressure to effect a first selected action and a second hydraulic actuator responsive to changes in hydraulic actuation pressure to effect a second selected action.

54. The end effector of claim 53, further comprising first and second relatively moveable jaws.

55. The end effector of claim 54, wherein the first hydraulic actuator is adapted to move the first and second jaws toward and away from one another.

56. The end effector of claim 53, further comprising first and second electrodes carried by selected of said jaws, wherein said electrodes are adapted for connection to the terminals of an electrical generator.

57. The end effector of claim 55, wherein each of the first and second jaws each comprises a scissor blade for cutting tissue.

58. The end effector of claim 54, wherein the first hydraulic actuator includes a longitudinally moveable piston and a connecting linkage associated with the piston and cooperative with each of the first and second jaws to move them toward one another upon increase of hydraulic pressure in the first hydraulic actuator.

59. The end effector of claim 55, wherein the first hydraulic actuator is biased to a position in which the first and second jaws are spaced apart.

60. The end effector of claim 54, further comprising a plurality of staples carried by the first jaw and a staple anvil carried by the second jaw.

61. The end effector of claim 60, wherein the plurality of staples are contained in a supply cartridge removably carried by the first jaw.

62. The end effector of claim 61, wherein the second hydraulic actuator is adapted to force the staples from the first jaw and against the anvil of the second jaw.

63. The end effector of claim 62, wherein the first jaw includes a moveable staple ejector and the second actuator includes a linearly extensible balloon engageable with the staple ejector to force the staples from the first jaw upon increase of hydraulic pressure in the balloon.

64. A hydraulic actuation handle for a hydraulically actuated medical instrument, comprising

first and second fluid flow paths;

first and second hydraulic pressure sources communicating with the first and second fluid flow paths, respectively, for changing the hydraulic pressure within each of the first and second flow paths; and

means for selectively actuating said first or second hydraulic pressure sources.

65. The handle of claim 64, further comprising a movable lever cooperative with one of the pressure sources for changing the hydraulic pressure in one of the fluid flow paths.

66. The handle of claim 65, further comprising:

a hydraulic cylinder block communicating with at least one of the hydraulic fluid flow paths;

a longitudinally moveable piston slidably movable with respect to the cylinder block for movement between at least a higher pressure position and a lower pressure position; and

the lever being pivotally mounted and engageable with the piston for moving the piston relative to the hydraulic cylinder block to change the pressure of the hydraulic fluid in at least one fluid flow path.

67. The handle of claim 66, wherein the piston further comprises a plurality of gear teeth and the lever includes a plurality of gear teeth engageable with the gear teeth of the piston.

68. The handle of claim 65, wherein the lever is biased to a position of lower hydraulic pressure.

69. The handle of claim 65, further comprising a release tab operable to engage the lever to hold it in an increased pressure state.

70. The handle of claim 64, further comprising a trigger cooperative with one of the pressure sources for changing the hydraulic pressure source in at least one of the fluid flow paths.

71. The handle of claim 70, further comprising:

a hydraulic cylinder block communicating with one of the hydraulic fluid flow paths;

a longitudinally moveable piston slidably movable with respect to the cylinder block for movement between at least a higher pressure position and a lower pressure position; and

the trigger being pivotally mounted and engageable with the piston for moving the piston into the hydraulic cylinder block to change the pressure of the hydraulic fluid in at least one fluid flow path.

72. The handle portion of claim 71, wherein the piston further comprises a plurality of gear teeth and the trigger includes a plurality of gear teeth engageable with the gear teeth of the piston.



73. The handle portion of claim 70, further comprising a safety latch engageable with the trigger to hold the trigger in a lower pressure position.

74. The handle portion of claim 64, further comprising:

a hydraulic cylinder block including first and second cylinders communicating with the first and second hydraulic fluid flow paths, respectively;

first and second longitudinally moveable pistons slidably movable with respect to the first and second cylinders, respectively;

a movable lever pivotally mounted and engageable with the first piston for moving the first piston relative to the cylinder block to increase the pressure of the hydraulic fluid in the first fluid flow path; and

a trigger pivotally mounted and engageable with the second piston for moving the second piston relative to the cylinder block to increase the pressure of the hydraulic fluid in the second fluid flow path.

75. The handle portion of claim 74, wherein the first and second pistons each further comprise a plurality of gears engageable with the lever and trigger, respectively.

76. The handle portion of claim 74, wherein the lever is biased to a position in which the first fluid flow path is at a reduced hydraulic pressure state.

77. The handle portion of claim 74, further comprising a release tab operable to engage the lever when it is in an increased pressure state.

78. The handle portion of claim 74, further comprising a safety latch engageable with the trigger to hold the trigger in a reduced pressure position.

79. A hydraulically actuated robotic medical instrument comprising:

a hydraulically actuated end effector;

an elongated shaft including a proximal end and a distal end, the end effector being carried at the distal end;

a remote hydraulic fluid pressure source;

a hydraulic fluid flow path extending from the pressure source, through the elongated shaft and to the end effector;

a remote robotic controller operatively associated with the pressure source for automatically selectively controlling the

pressure source for selected actuation of the end effector in response to user command.